

What is Claimed is:

- 1 1. A separator for electrochemical cells, comprising:
2 a gas barrier having an electrically conducting pathway extending therethrough;
3 a porous, electrically conducting member in electrical contact with each side of the
4 electrically conducting pathway, the member selected from the group consisting of expanded metal
5 mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations
6 thereof.
- 1 2. The separator of claim 1, wherein the electrically conducting pathway through the gas barrier
2 is formed from a second porous, electrically conducting member selected from the group consisting
3 of expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material
4 and combinations thereof.
- 1 3. The separator of claim 1, wherein the gas barrier is a metal.
- 1 4. The separator of claim 1, wherein the gas barrier comprises a polymer.
- 1 5. The separator of claim 1 further comprising a cooling fluid channel within the gas barrier.
- 1 6. The separator of claim 1, wherein the gas barrier and the porous, electrically conducting
2 member are essentially parallel.
- 3 7. A separator for electrochemical cells, comprising:
4 a porous, electrically conducting sheet selected from the group consisting of expanded metal
5 mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations
6 thereof; and

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1 a gas impermeable material disposed within a portion of the sheet to form a gas barrier.

2 8. The separator of claim 7, wherein the gas impermeable material is selected from the group consisting of polymers and metals.

1 9. The separator of claim 7, wherein the gas impermeable material is a polymer selected from
2 the group consisting of water permeable polymers, thermoplastic polymers, reactively cured
3 polymers, and combinations thereof.

1 10. The separator of claim 7, wherein the gas impermeable material is an epoxy.

1 11. The separator of claim 7, wherein the gas impermeable material is a thermoplastic polymer
2 selected from the group consisting of polyethersulfone (PES), nylon, and polycarbonate.

1 12. The separator of claim 7, wherein the gas impermeable material is a perfluorinated sulfonic
2 acid polymer.

1 13. The separator of claim 7, wherein the gas impermeable material is selected from the group
2 consisting of titanium, stainless steel, aluminum, magnesium and alloys thereof.

1 14. The separator of claim 7, wherein the gas barrier is formed along one face of the porous
2 sheet.

1 15. The separator of claim 7, wherein the gas barrier is formed within a central portion of the
2 porous sheet.

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2 16. The separator of claim 7, further comprising a second porous, electrically conducting sheet
3 selected from the group consisting of expanded metal mesh, metal foam, conducting polymer foam,
4 porous conductive carbon material and combinations thereof, wherein the second porous sheet is in
electrical contact with (the side of the porous sheet) having the gas barrier.

1 17. The separator of claim 6, wherein the cooling fluid channel.

1 18. The separator of claim 16, wherein the cooling fluid channel is disposed through or in
2 contact with the gas impermeable material.

1 19. The separator of claim 17, wherein the cooling fluid channels comprise a plurality of cooling
2 fluid tubes.

1 20. A separator for electrochemical cells, comprising:
2 two porous, electrically conducting sheets selected from the group consisting of expanded
3 metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and
4 combinations thereof; and
5 an electrically conducting gas barrier disposed in electrical contact between the sheets.

1 21. The separator of claim 18, wherein the electrically conducting gas barrier) is a metal sheet.

1 22. The separator of claim 19, wherein the metal sheet is titanium.

1 23. The separator of claim 19 further comprising a polymeric cell frame peripherally enclosing
2 a porous electrically conducting sheet.

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2 *Sub 27* 24. The separator of claim 23 wherein the polymeric cell frame includes channels in fluid communication with the porous electrically conducting sheet.

1 25. The separator of claim 20, wherein the porous, electrically conducting sheets have
2 interdigitated channels communicating to the edge of the sheets.

1 26. The separator of claim 20 further comprising a cooling fluid channel within the electrically
2 conducting gas barrier.

1 27. A fluid cooled bipolar plate comprising:
2 an electrically conducting anode flow field;
3 an electrically conducting cathode flow field; and
4 an electrically conducting cooling fluid flow field in electrical communication between the
5 anode flow field and the cathode flow field, wherein the cooling fluid flow field includes fluid
6 impermeable barriers defining a fluid passage.

1 28. The fluid cooled bipolar plate of claim 27 further comprising cooling fluid inlet and outlet
2 manifolds connected to the cooling fluid flow field.

1 29. The fluid cooled bipolar plate of claim 27 further comprising a frame disposed around the
2 cooling fluid flow field.

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